RESIBLOC®
Dry Type Distribution Transformers
250 kVA up to 40,000 kVA
Mission

ABB is a global leader in power and automation technologies that enable utility and industry customers to improve performance while lowering environmental impact.

Introduction to ABB

ABB is the world’s leading supplier of Distribution Transformers. We offer:

- All technologies (Dry/Liquid)
- All standards (IEC, ANSI, etc)
- Applications up to 72.5 kV

Facts and figures (approx)

- Production facilities around the world: 30
- Countries with Sales and Services centers: 140
- Number of units produced yearly: 400,000

Working with us, you have access to a worldwide network of factories and facilities serving you locally with a full range of products and solutions. Our warranty provides one ABB quality and service. Working together gives you access to production facilities using the most up to date technologies, providing the highest quality for standard and specialty products as well as solutions.

Quality statement

Our production facilities are ISO 9001/14001 certified. Our aim is to deliver your distribution transformers fast, on time and conform to your specifications.
The Challenge: Environmental Safety & Security

Environmental protection demands are today constantly rising. Ever more frequently, dry type transformers user specifications are focused on creating minimum environmental contamination and providing the very lowest flammability risks. For this reason, our transformers must today constantly meet more stringent parameters with respect to electrical system demands, as well as more extreme operating conditions. Applications today include: high-rise office and public buildings, nuclear power plants, offshore petrochemical platforms, and high output industrial process plants.

Development of many new technologies has enabled our transformer designers to apply modern materials with the very latest of processes, increasing the transformers durability while ensuring unprecedented product reliability.

If any of the following demands form part of your transformer application, then ABB has the necessary solution:

- No environmental or human contamination risks
- Non-explosive and extreme fire resistance
- Heavy loading cycles (from cold starts to full loading)
- High short circuit withstand
- Exposure to extreme conditions (arctic, tropic, chemicals, moistures etc)
- Harmonic overloading, over-voltage peaks or variable load factors
- Minimum maintenance

The solution: RESIBLOC® - the cast resin transformer

For over 30 years, we have produced and supplied cast resin transformers all over the world. RESIBLOC® transformers answer the need for a safe, reliable transformer designed to fulfil the most exacting specification requirements, whilst providing a non-flammable, environmentally safe product.

The glass fibre reinforced RESIBLOC® transformer offers an extremely robust and proven design for medium voltage transformer requirements, conforming to IEC 60076-11 standards.
Main technical data

- Power rating (AN) 250 kVA to 40,000 kVA
- Rated voltage up to 45 kV

Classification acc. to IEC 60076-11
- Climatic classification C2
- Environmental classification E2
- Fire classification F1

Compact self-supporting winding in a one-piece block – optimum to withstand short-circuit-forces

Cylindrical cooling-ducts provide the advantage of optimal cooling through the inner coil

Aluminium or Copper foil used in LV-winding

High short circuit withstand through prepreg resin impregnated LV-foil winding

Self-extinguishing in the event of secondary fire or arcing and no raised danger potential as no toxic gases are released
Glass fibre reinforcement - guarantee against cracks

Pure epoxy resin reinforced with glass fibre rovings is a material of enormous strength. Modern winding processes, combined with electronically controlled winding machinery, ensure an even distribution of glass fibre rovings and epoxy resin and the highest precision in the manufacture of transformer windings. Multi-spaced ribs, built-in during the winding process, integrate the HV and LV windings into a single compact winding block.

Low voltage windings

In RESIBLOC® transformers either aluminium or copper foils are used in the low voltage winding, with thermal class F prepreg windings insulation. From the use of a foil winding, a considerable reduction in axial short circuit forces is obtained.

To raise the space factor on smaller rated transformers, the LV-windings are produced using a wire layer winding. LV-windings that are to operate with system voltages higher than 1.1 kV are produced in the same manner as the high voltage windings.

Whenever necessary to ensure satisfactory cooling, the LV-windings are equipped with additionally axial cooling ducts.

High voltage windings

The cylindrical high voltage windings are wound directly on the LV-windings, in a further production process.

The RESIBLOC® transformers’ superior lightning impulse voltage withstand results from the linear impulse voltage distribution, obtained through use of the layer-winding concept.

Circular, or for larger cross-sections, rectangular copper conductor material to insulation class H is used. The outer encapsulation and the intermediate layer winding insulation consist of insulation class F glass fibre reinforced epoxy resin material, applied during the ROVING-winding process.

The finally completed winding block is cured under rotation, in purpose designed curing ovens.
Glass fibre rovings

Layer insulation with glass fibre cross bandage

HV layer winding
Core & Coils -
Optimal Materials & Design Geometry

The glass fibre portion of approx. 80%, combined with glass fibre cross and radial bracings are introduced during the winding process. Exceptionally powerful winding blocks result, with high mechanical strength in both axial and radial directions.

Windings with high short circuit withstand levels and extreme thermal shock stability at highest and lowest temperature levels result. The risks of cracking, resulting from different thermal expansion coefficients between conducting and solid resin insulation materials, are effectively prevented for the transformers total lifetime. Furthermore, cracking caused under extreme operational conditions, i.e. arctic frozen climates or following surge overloads will never arise.

Multiple cooling channels, located within the HV-windings of larger rated transformers enable these to be made as self cooled units (AN). The glass fibre roving technology makes it possible to produce the largest windings as a single piece, due to the exceptionally high mechanical strength achieved from this form of solid insulation.

The windings are effectively protected against mechanical and chemical effects, through the encapsulation with glass fibre reinforced epoxy resin insulation materials, insensitive to humidity and practically maintenance free.

As no casting moulds are used to manufacture the RESIBLOC® transformers, customised windings, built to a customers specification are easier produced. The smooth outer surfaces of the winding restrict dirt and dust from accumulating.

By using the block winding principle, both high and low voltage windings are bound together by multi-spaced ribs, forming a single, solid block. Any movements resulting from either axial or radial forces during short circuit are therefore prevented. The block winding principle ensures HV- & LV-winding spacings, vital for voltage withstand is guaranteed, and will remain unchanged during short circuit, or transformer movement.

RESIBLOC® windings

Cross section of RESIBLOC® winding
Core design

The core design is an important factor for the quality of any transformer. The core materials are geometrically arranged, and greatly determine the unit’s loss and noise levels.

Grain oriented transformer sheet core steel is used in the core construction, cut from rolls on the most modern, fully automated core cutting machinery and stacked into limb and yoke packages. The use of the best space factor and highest dimensional accuracy result in low core losses and noise values.

The limb and yoke core section joints are interleaved and mitred at 45°, creating the optimum conformity of magnetic flux pattern to the preferred magnetic flow. The modern step-lap technology (SLT) creates multiple stepped joints between the limbs and yoke sections. Every core is given a protective epoxy resin finish, a lasting protection against corrosion. The block windings are firmly braced to the core using purpose made resin insulation strips.

Mechanical structure

The RESIBLOC® transformers yoke laminates are firmly held together by steel core clamps. The upper and lower yoke core clamps are connected through core tie-strap.

RESIBLOC® transformers are provided with flat rollers, enabling both longitudinal and traverse movement. To raise the transformer, four lifting holes are situated in the upper core clamps, designed for use with a chain or cable, with a lift angle of $\geq 60°$.

Finish

The RESIBLOC® transformer frame, core clamps, etc. are given a final RAL 2000 finish colour.
Tested one by one

Tests
Prior to dispatch, every single RESIBLOC® transformer undergoes a detailed individual test and inspection, including all routine tests according to IEC 60076-11 and VDE 0532. These includes:

Routine Tests
- Measurement of voltage ratio and check of phase displacement
- Separate-source AC withstand voltage test (applied voltage)
- Induced AC overvoltage withstand test
- Measurement of no load loss and current
- Measurement of winding resistance
- Measurement of impedance voltage, short-circuit impedance and load loss
- Partial discharge measurement
- Function- and insulation test of control wiring, auxiliary operation, tests on on-load tap changers, where appropriate

Additional type- and special tests can be executed on request:

Type Tests:
- Lightning impulse (LI) test
- Temperature-rise test

Special Tests:
- Determination of sound levels
- Determination of capacitances of windings to earth and between windings
- Measurement of zero-sequence impedance(s) on three-phase transformers
- Measurement of the harmonics of the no-load current
- Measurement of insulation resistance to earth of the windings, and between the windings
- Partial discharge measurement for isolated networks

Fire safety
RESIBLOC® transformers can safely be characterised as hard to ignite or self-extinguishing. Less than 5% of the materials used can burn if the transformer is drawn into a normal fire. Tests have proven that RESIBLOC® transformers fulfil the requirements of Fire Behaviour Class F1, acc. to IEC 60076-11:

- No toxic gases, and no gases appear other than those present in any normal fire.
- This very favourable fire behaviour is a direct result from the use of approx. 80% glass fibre content in the insulation material.
- The excellent self-extinguishing effect is achieved without using any environmentally undesired halogens.
Deep-freeze temperature test at -60°C

RESIBLOC® transformers have been severely tested at the Department of High-Voltage Dielectric Testing of Karlsruhe University:

The RESIBLOC® transformer passed a deep-freeze temperature storage test at -60°C, whereas the class C2 according to VDE 0532 part 6 and IEC 60076-11 requires only -25°C.

Additionally, 3 thermal shock load tests have been made: 2 tests at double rated current at -60°C and a third test with 2.55 times rated current, also at -60°C. VDE requires only 1 test to be made at -25°C. Full IEC 60076-11 routine tests, as well as a partial discharge test were performed before and afterwards.

These tests prove that the RESIBLOC® transformers exceed the requirements of VDE 0532 resp. IEC 60076-11, class C2. Therefore the RESIBLOC® is very well suited for operation in arctic conditions and for applications with strongly variable loads.
The precise enclosure for any site

**Enclosure protection**

Standard RESIBLOC® transformers are supplied as protection class IP 00, i.e. without enclosures. Additional enclosure protection to different protection classes are possible.

**General design**

All enclosures are manufactured using galvanised sheet steel, with an optional paint finish on request. The enclosures use bolt on, lift-off, front and rear panels for easiest cable connections and reconnection of HV-voltage tappings. Cable entry cut-outs are provided in the enclosure base-plate.

To ensure adequate cooling air supply, a space must exist between the enclosure base-plate and the floor. The recommended cooling air volume is approx. 4m³ per kW per minute of dissipated heat loss at 75°C operating temperature.

**IP 21 enclosures**

Enclosures to the class IP 21 provide entry protection against solid objects ≥ 12 mm diameter and dripping water. This enclosure type is supplied with grilled base-plate and side-mounted grills to front and rear, enabling good cooling airflow.

**IP 23 enclosures**

The IP 23 enclosures offer more protection than the IP 21, with resistance to dripping water up to a vertical 60° angle. Outdoor units will need additional rain covers over the grills, to avoid any rainwater entry.
Specially adapted units are available.

**Special enclosures**

Specially designed enclosures can be provided, suitable to individual customer requirements, i.e.:

- Protection class IP X4D provides entry protection against solid objects > 12mm and also protects against entry of wire ≥ 1mm. Additionally, this protection class prevents the entry of sprayed water from all directions.
- Protection class IP 54 offers - in addition to IP X4D – complete touch protection and protection against accumulation of dangerous dusts. The enclosure is provided with a cooler on ratings above 1000 kVA, either as air-water or air-air cooler.

On request, we will gladly bid enclosures to other protection classes.

Enclosures in stainless steel or in other materials can be provided.
Enclosure IP 54

Special outdoor enclosure

IP 23 enclosure with raincover and OLTC
RESIBLOC® - special designs for special applications

Although the standard design of RESIBLOC® cast resin transformers and regularly manufactured enclosures satisfy most of our customers needs, special operating or site conditions will always demand the creation of special designs.

The flexibility in the RESIBLOC® concept enables most requirements to be fulfilled. Variations such as single phase, 3-winding transformers, or transformers with special terminal arrangements, cable supports, flange connections to match busbar systems, are regularly being dispatched to clients worldwide. RESIBLOC® transformers can be supplied with additional equipment, for example: earthing switches, load or no-load break switches and fuses etc.

The RESIBLOC® is regularly produced in the following Special Designs, and used for the following Special Applications:

- Single phase transformer
- Triple winding/Dual secondary transformer
- Dual HV winding transformer
- Energisation transformer
- Oven transformer
- Rectifier transformer
- Auto transformer
- Traction transformer
- OLTC transformer
- Railway applications
- Marine: propulsion & distribution
- Nuclear energy
- Windmill power
- Mining duty
RESIBLOC® single phase transformer

LV busbar termination

20 MVA RESIBLOC® transformer with on load tap changer
Overloadable to the limit, without risk

Overload capability
The favourable long time-constants of cast resin transformer windings allow short-period high overloads during operation. Full benefit can be taken from this, when considering the transformers power rating. When prior to the overload, the RESIBLOC® transformer is only partially loaded and/or operated at a lower ambient temperature than it’s design value, the windings end temperature of 155 °C will not be exceeded by specific overloads.

Overload protection
High ambient site temperatures, inadequate cooling air-flow and heavy system loads may result as a transformers thermal overloading. Every RESIBLOC® transformer should have a temperature monitoring system installed for maximum protection and safety.

The typical temperature monitoring system would be equipped with PT100 sensors and controls all 3 winding phases.

Forced air cooling
RESIBLOC® transformers can optionally be equipped with cross-flow cooling fans. These fans will increase the rated output of the transformer by up to 40 % and have low noise levels and ideal long time control of irregular overloads.

Thermal sensors automatically control the fans, avoiding excessive and unnecessary use of the cooling fans.
Technical data

RESIBLOC® transformers can be supplied with rated voltages up to 45 kV. The HV-windings can be supplied with reconnectable tappings, to function from numerous voltages.

Tapping range
The standard tapping range is ±2 x 2.5%. Other tapping ranges are available on request.

Impedance voltage
For impedance voltage values refer to the table on page 20. Transformers with other impedance values are available on request.

Connection groups
Standard connection group is either Dyn 5 or Dyn 11. Other vector groups are available.

Temperature rise
Standard RESIBLOC® transformers are by design restricted to 100 K, the temperature rise limit of class F according to IEC 60076-11 and VDE 0532.

Noise levels
Noise levels are detailed in the table on page 20, and shown in sound-power levels. These levels apply for IP 00 transformers, measured at 1 m distance.

Tolerances, according to IEC:

1. Losses
   a) Total losses
      + 10 % total losses

   b) No-load and/or load losses
      + 15 % of no-load or load losses on condition that the tolerance for total losses are not exceeded.

2. Voltage ratio
   Rated voltage ratio (principal tapping) the lower of the following values:
   a) ± 0.5 % of the obligatory rated value
   b) a percentage of the obligatory voltage ratio which equals ± 1/10 of the measured rated impedance voltage percentage

3. Impedance voltage (principal tapping)
   ± 10 % at rated current

4. Impedance voltage for other tappings
   ± 15 % of agreed value for this tapping

5. No-load current
   + 30 % of the obligatory no-load current

Transformer for 60 Hz
Transformers designed for 50 Hz operation can also operate on a 60 Hz supply with the following amendments to the technical data:

   Power: approx. 97 %
   No-load losses: 80 - 85 %
   Load losses: approx. 105 %
   Impedance: 115 - 120 %

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Service conditions

Maximum temperatures

Unless otherwise requested, the RESIBLOC® transformer is designed to meet the maximum temperature limits as defined in the standards IEC 60076-11 and VDE 0532, part 6:

- Maximum ambient temperature: 40 °C
- Average of the hottest month: 30 °C
- Average in any one year: 20 °C

Standard RESIBLOC® transformers can be used in ambient temperatures up to 55 °C, provided correctly reduced loads are applied. As a guide, for each 10 °C increased ambient temperature, a 7% load reduction must be observed. Specially designed, fully loadable units for use in higher cooling air conditions are available.

Minimum temperatures

The colder temperatures are of special interest for the dry type transformers, not only during transport and storage, but also in service. The RESIBLOC® transformer can be placed in operation at temperatures as low as -60°C, without special considerations. There are no restrictions, even after longer periods of low loading, or lengthy times completely switched-off. The extreme mechanical strength of the glass fibre reinforced cast resin roving windings eliminates any danger of cracking in the windings.

Altitude

According to IEC 60076-11 and VDE 0523, part 6, a normal height above sea level of 1000 m (3300 feet) must not be exceeded. For operation at higher altitudes, a special technical design is necessary to allow for the cooling air and the dimensioning of the electrical air insulation distances.

Humidity and pollution

The RESIBLOC® transformer is designed according to the demands of IEC 60076-11 class E2. The RESIBLOC® is for use under extreme service conditions, with high humidity levels, frequent condensation and/or pollution and for normal outdoor application in proper ventilated enclosures.
Outline drawing - standard ABB RESIBLOC® transformer IP 00

1 HV terminal
2 LV terminal
3 LV star point
4 Ground earth. Terminal
5 Rating plate
6 Terminal strip
7 Lifting eyes

Outline drawing - standard ABB RESIBLOC® transformer IP 23

1 HV terminal
2 LV terminal
3 LV star point
4 Ground earth. Terminal
5 Rating plate
6 Terminal strip
7 Lifting eyes
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<th>Power (kVA)</th>
<th>HV / LV (kV)</th>
<th>Impedance (%)</th>
<th>No-Load loss (W)</th>
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Subject to change
Distribution transformers offered by ABB

Liquid filled distribution transformers:
- up to 72.5 kV
- single phase and three phase
- ground mounted, pole mounted or pad mounted

Dry transformers:
- Open Wound
- Vacuum Cast Coil
- RESIBLOC® Dry Type Transformers

Transformers for special applications:
- Railway application
- Marine: propulsion and distribution
- Carrier Vessel Nuclear
- Rectifier Transformers
- Variable Speed Drive
- Excitation Transformers
- HVDC Converter
- Transformers for windmills
- Autotransformers
- Grounding/Earthing Transformers
- Neutral Earthing Reactors
- Current Limiting Reactors
- Arc Furnace
- Boostertransformers

Services offered by ABB Distribution Transformers
- Installation and Commissioning
- Training
- Testing and maintenance
- Retrofits, Revamping and up-grading
- Spare parts procurement

Technical information available from abb.com/distributiontransformers